Reliable Data Transmission Using Improved Packet Retransmission Timeout Calculation For Wireless Sensor Network
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Abstract—Congestion in network due to heavy traffic of data is major problem in wireless sensor networks now days. Large are wireless sensor networks, which consists of more than 1000 nodes in network should be reliable, because missing a single packet of information can cause a big event. On the other hand time saving is other issue. Sender can’t transmit other important information until it gets acknowledgement of previous packet. In this time gap, receiver will be unaware if any event occurs. This paper presents a mechanism to save time and utilize the time gap, so that it can’t miss any event information. The improved mechanism has been included in TCP NewReno. The implementation of proposed technique is done in Qualnet 5.0. Results are described in result section.

Keywords—wireless network; TCP timeout; TCP NewReno TCP variants.

I. INTRODUCTION

Wireless sensor networks [1] can be described in terms of thousands of small devices responsible of computation, communication and sensing. These small devices are called MOTE [2]. The MOTEs are deployable in real time application to protect large area. Figure 1 shows a wireless sensor network, dashed lines shows wireless links between nodes. The sensor attached with the MOTE senses the environmental signals, processor/microcontroller perform computing to identify the events. The communication devices are transceivers which receive and transmit event information to the base station through multihoping [3].

The packets of event information transmitted in network required certain protocols to reach the destination. There are several routing protocols exists for WSN. Static routing [4] is preferable in the case of multihop transmission.

The other required protocol is MAC [5] protocol. Energy of MOTE to sense and transmit the information in WSN is a major issue. Various protocols are exists for MAC, but till now not any MAC protocol is suitable for WSN. Still development and research are going on. Other than energy saving protocol, few media access protocol with collision detection and avoidance are used for WSN.

After MAC protocol, the most important protocol is TCP [6], which is required for reliable packet transmission. The successful packet transmission to the base station is very essential. Any serious event can take place, if packet transmission fails. In WSN packet loss occurs due to weather conditions, obstacles, multipath interferences, signal attenuation and fading. There are many nodes which can transmit event information at the same time. It may cause congestion in network. There are various variants have been proposed to reduce congestion effects, TCP Tahoe [7,8,9], TCP Reno [8], TCP Reno with Selective Acknowledgement (SACK) [7,8], TCP NewReno [10, 11], TCP Westwood [11] TCP Vegas [12], and TCP FACK [13] are examples of proposed end-to-end solutions. They are all proposed to improve network performance.

This paper presents an improved retransmission time out condition in TCP New Reno. The mechanism adapts the value of retransmission time to retransmit the unacknowledged packet and calculate new retransmission time-Out value. The detail descriptions are given in the following sections.

There are various researches going on to reduce effect of congestion and to make reliable communication by implementing transmission control protocol. Few of the research are as follows.

H. Kumar et. al. [14] has proposed a congestion control mechanism for MANET. In proposed technique the particular channel, queue length of packet, traffic rate based overall congestion standard, packet loss rate and packet dropping ratio are calculated to monitor the congestion status in network. According to congestion status, a routing protocol has been...
developed. The proposed routing protocol with conventional TCP has been implemented and compared by author. As results shows proposed technique is better.

N Sharma et. al. [15] has implemented various parameters to identify the non-congestion losses of TCP in MANET. Author has implemented parameters in NS-3 simulator, simulate the communication and then observe the performance of MANET in different scenarios.

Yuwono et. al. [16] compared two TCP congestion control algorithms. The algorithms are Cubic TCP and Yeah TCP by using BATMAND in several static and mobile node scenarios. Author has investigated the performance of both TCP variants by changing in slow start window. According to the results Yeah TCP has better performance due to its capability to anticipate loss events on MANET.

Chien-Chia Chen et.al. [17] has proposed a network coded multipath scheme based on random linear coding scheme with adjustable redundancy, multipath routing, and ACK Piggy coding. Simulation result shows the proposed method is efficient in 3-hop static scenario.

Above literatures shows new path to develop new mechanism to reduce congestion effects in network. The following sections will present the implementation of proposed mechanism.

Organization of paper: section II presents the proposed mechanism, section III describes the simulation of network, and section IV presents results of simulation.

II. PROPOSED MECHANISM

The data transmission in network uses TCP protocol for reliable transmission, because receiver sends acknowledgement for each packet. But in this case sender has to wait until it gets acknowledgement. Sender has no option to send packet even it has to send any important information.

TCP start a timeout timer when it transmit a packet, and wait for acknowledgement. If acknowledgement of packet lost in the network, TCP retransmits the packet and double the timeout timer. Reliability of packet transmission, costing enough time waste during communication. The enhance mechanism for data transmission calculates retransmission timeout, so that it can reduce time wastage during retransmission of packets.

The enhanced mechanism for data transmission is as follows.

A. Initial Window

The initial sending window is calculated by following formula:

\[ Iw = \min (4 \times SMSS, \max (2 \times SMSS, 4380 \text{ byte})) \]

B. Slow-Start Algorithm

The slow start algorithm is used to start a connection and the periods after the value of retransmission timer exceed the RTO (retransmission timeout). The size of cwnd will be initialized to 1.

The slow start algorithm describes as below:

\[
\text{if (Receive ACKs && cwnd < ssthresh)} \\
\text{cwnd = cwnd+1;}
\]

C. Congestion Avoidance Algorithm

The congestion avoidance algorithm describes as below:

\[
\text{if (Receive ACKs || (Receive Explicit Packet Loss Notification))}
\]

\[
\text{if (cwnd > ssthresh)} \\
\text{cwnd = 1+1/cwnd}
\]

\[
\text{else}
\]

\[
\text{cwnd++;}
\]

D. Fast Retransmission and fast Recovery

\[
\text{if (Congestion || Heavy Packet)} \\
\text{if (Receive Same ACK 3 Times || Retransmission Timer Overtime) /* Congestion */}
\]

\[
\text{Ssthresh = max(flightsize/2, 2*SMSS);} \\
\text{// Flightsize are those data which have no acknowledged}
\]

\[
\text{if (Retransmission Timer Overtime)} \\
\text{cwnd = 1; Exit and call slow-start;}
\]

\[
\text{else /* Receive Same ACK 3 Time */}
\]

\[
\text{RTT\_new = (1 - t1) RTT\_old + t1 \times RTT} \\
\text{Where, t1 = 1/8}
\]

\[
\text{RTO = RTT + 6 \times RTT\_new}
\]

\[
\text{Re\_trans\_new = 1 + (rtt - min\_rtt) / (max\_rtt - min\_rtt)}
\]

\[
\text{Reset\_RTO = Re\_trans\_new \times RTO\_old}
\]

\[
\text{cwnd = ssthresh;}
\]

III. COMPUTER SIMULATION

The implementation and simulation has been done in QualNet 5.0 [18] network simulator. The scenario for experimentation is as follows:

- Mobility model Random Way Point
  Speed of nodes 30 mps
  Pause time 5s, 10s, 15s, 20s, 25s, 30s.
  Simulation Time 200s
- **Terrain**: Coordination 1500 * 1500 m
- **Connection**: FTP (File transfer protocol): client to server
  - Item size 512(byte)
- **Radio/physical layer parameters**:
  - Radio type: 802.11b Radio
  - Data rate: 2Mbps
  - Packet reception model: Bit error rate (bpsk.ber)
- **MAC Protocol**: 802.11
- **Routing Protocol**: DSR
- **Transport Protocol**: TCP Variants
- **No. of Node**: 10, 20, 30, 40, 50
- **Node Placement**: Random

Performance metrics used for this work are throughput, signal received with error, bytes received and packet loss.

### IV. RESULTS

Following graphs shows the output of simulation after implementation of proposed protocol. The result of ATTCP (Adaptive Timer TCP) is compared with result of TCP New RENO and TCP TAHOE.

**No. of Node Vs Packet Received**

**No. of Node Vs Packet Delivery Ratio**

**No. of Node Vs Packet Retransmitted**

**No. of Node Vs Throughput**

**Node Speed Vs Packet Received**
Figure no 2-6 shows the effect of increasing traffic in network. X-axis shows number of nodes and Y-axis shows the corresponding values of parameters. Figure no 7-10 shows the effect of increasing speed of nodes in network. X-axis shows speed of nodes (m/s) and Y-axis shows the corresponding values of parameters. It can be observed that in most of the cases either in dense network or variation in pause time, the performance of ATTCP is better than other TCP variants. The simulation result shows that ATTCP is more reliable and less time consuming. The packet retransmission rate is more than other variants. It can be used in sensitive networks.

V. CONCLUSION

This paper presents a mechanism to make TCP more reliable and time saving protocol. The new mechanism uses a calculation of retransmission timeout by which sender has to wait for minimum duration to send a new packet or retransmit old packet. The variant of TCP is implemented on QualNet 5.0. According to the simulation results new variant of TCP, ATTCP is working better than other TCP variants. ATTCP is more reliable, so it can be used in most sensitive places, where real time event monitoring is required in limited time constraints.

REFERENCES


